

# A Generalized Modeling Framework for Climate Change Damage Assessment

Alex Marten, Steve Newbold,  
Charles Griffiths, Elizabeth Kopits,  
Chris Moore, Ann Wolverton

National Center for Environmental Economics,  
U.S. EPA



\* Please note that the views expressed are those of the authors and do not necessarily represent those of the U.S. EPA.  
No Agency endorsement should be inferred.

# Lessons Learned

---

- Need a more transparent representation of the pathways through which climate change may affect economic productivity and human well-being
  - Need a transparent method of incorporating new research on climate damages into modeling exercises
  - Desire to more transparently map assumptions of economic behavior (e.g., adaptation, technology diffusion) into economic damage estimates
  - Need for reduced form IAMs that allow for a relatively timely assessment in a probabilistic fashion
-

# Reasons for a New Framework

---

- Help facilitate the process of incorporating new climate science and economic damage research
- To clearly distinguish among damages to market sectors, physical and natural capital stocks, and human health while also accounting for defensive expenditures<sup>⌘</sup>
- Standardization so that the effects of specific assumptions/pieces may be better understood
- Increased transparency through complete, accurate, and up-to-date documentation and open source code
- To make climate-economic integrated modeling more accessible to government and researchers

<sup>⌘</sup> Defensive expenditures is used here to refer to expenditures borne in order to offset the effects of worsening environmental quality.

# Key Characteristics of Framework

---

- **General** structure that nests commonly used integrated assessment models, including the three used by the interagency workgroup
  - **Flexible** framework so that new findings and assumptions may be easily incorporated
  - **Transparent**, in that the code, framework, calibrations, and assumptions will be well documented and freely accessible to researchers and other interested parties
  - **Probabilistic**, to allow for formal uncertainty analysis in a Monte Carlo framework
  - **Modular** design allows for linkage with multiple climate models and future additions of new impact categories
    - For example: Would allow for standardization in climate and economic assumptions across various calibrations of the damage functions (and vice versa)
-

# Overview of Structure

---

- Climate model coupled to a regionalized exogenous growth model of the economy
  - Exogenous technical progress and population growth (potential for climate-population feedbacks)
  - Currently uses exogenous emissions scenarios (retains the option for endogenous emissions in the future)
  - Currently uses MAGICC as the climate model (may use others; such as those included in DICE, FUND, and PAGE)
  - Ability for natural capital to be represented
  - Setup to run probabilistically
-

# Representation of Damages

---

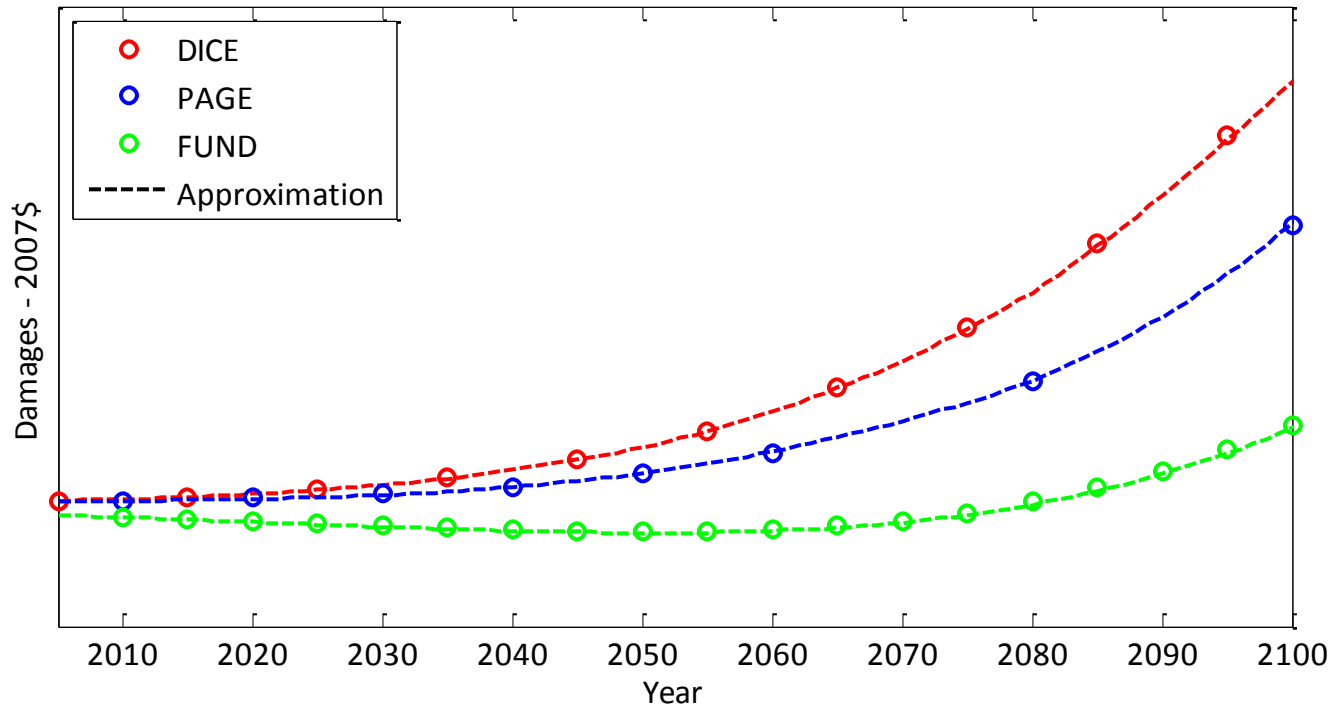
- Distinguishes between different types of climate change damages to provide for transparency and ensure that they are affecting the correct end points in the model
    - Damages to multiple market sectors
    - Damages directly to physical capital
    - Defensive expenditures offsetting investment in physical capital
    - Defensive expenditures offsetting household consumption
    - Consumption equivalent health damages
    - Consumption equivalent recreation and nonuse damages
  - Use of general functional forms so that the model remains flexible
-

# Current Status

---

- Prototyping of framework and initial testing
    - Development of initial code base
    - Including interface for public version of MAGICC, along with versions of the DICE, FUND, and PAGE climate models
  - Ongoing development of clear and accurate documentation for the framework
  - Testing generality by using specific settings to closely approximate versions of DICE, PAGE, and FUND similar to those used by the interagency workgroup
-

# Approximation of Other Models



- The central values of parameters are used in this exercise
- Approximation of FUND does not yet include all the damage sectors that are in the full model



# Next Steps

---

- Continual refinement of the model in response to prototyping
  - Full approximation of FUND
  - Incorporation of feedback from workshops
  - Starting from the studies currently used in existing IAMs move forward with incorporating new studies on climate change damages
  - External peer review
  - Eventual public release
-